

# SOILutions

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## HERBICIDES AND RESISTANCE - Too Much Of A Good Thing?

*Linda Hall and Denise Maurice,  
Weed Scientists*

**Herbicides do a great job** of controlling weeds, giving your crop the edge it needs, but you can have too much of a good thing. Repetitive use of herbicides can select weeds that are unaffected by that herbicide or herbicide group. These weeds produce seeds and spread in the field. What the producer sees is poor control with a product that used to work very well or patches of weeds that may be confused with a herbicide miss.

**Not all herbicide groups are equal** when it comes to selecting for resistant weeds. We have successfully used Group 4 (2,4-D family) for many years with few occurrences of herbicide resistance. However, some of our most effective new herbicides can select for herbicide resistant weed populations in 4 to 7 years of repeated use. Herbicides that are prone to developing resistance have several attributes in common. They are selective and effective. They affect a single target site and leave few survivors. These herbicides are widely used. Once a weed develops resistance to a herbicide in a group, it is frequently resistant to other members of that herbicide group. For example, some wild oats resistant to Hoe-Grass are also resistant to Puma, and other Group 1 herbicides.

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## 1995 OBSERVATIONS FROM THE FIELD - A Pathologist's View

*Ieuan Evans, Plant Pathologist*

**Copper deficiency** symptoms in wheat and barley were widespread in west central areas this year. Symptoms such as crop lodging, melanosis of the wheat, ergot in wheat and barley and herbicide interactions (delays in maturity or dwarfing of the crop) were linked to copper deficiency. Grain fields showing some or all of these problems were particularly evident in the Beaumont, Stony Plain, Calmar, Wetaskiwin and Ponoka areas.

In the Richmond Park area of Athabasca (north of the river), a wheat and canola grower applied about 2 lbs of actual copper to 2,000 acres of hard red spring wheat. His soil analysis was 0.4 ppm and copper additions were recommended. This grower harvested his 50 bu/ac crop of CW #1 10 days earlier than his neighbours. His neighbours harvested 40-50 bu/ac of #2 and #3 wheat. The increase in quality resulting from the earlier maturity gave a \$0.50 premium / bushel (\$25.00 / ac) that more than paid for the \$8.00 / ac cost of the copper application.

**Sclerotinia** levels in most areas were the lowest they have been for many years. The very late rains (mid-July) allowed the canola crop to miss heavy sclerotinia infection. The sclerotia need 10-14 days of wet soil before they germinate and form spore producing mushrooms. Germination took place in late July and by this time flowering was virtually over. Growers who made the decision not to spray with fungicide saved both money and time.

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## Herbicides and Resistance - Continued

**Not all weeds are equal** in their ability to develop herbicide resistance. Some weeds (Table 1) have developed resistance in many sites in Alberta, while other weed species growing beside them have not. The weeds that develop resistance seem to have one thing in common; they are one of the most abundant weeds in the field.

**Table 1. Some of the weeds which have developed resistance in Alberta**

Herbicide Group	Resistant Weed(s)	Occurrence	Location
Group 1 Hoe-Grass	Wild Oats	8	Medicine Hat region, Wetaskiwin
Group 2 Glean, Ally, Refine, Muster	Kochia Chickweed Wild Mustard	1(?) >100 1(?)	Scattered throughout Alberta
Group 3 Edge and Treflan	Green Foxtail	1	Wainwright
Group 8 Avenge/ Avadex	Wild Oats	>50	Barrhead, Lacombe (16), Bentley (3), Ponoka, Airdrie, Innisfail, Dawson Creek, Stony Plain

**What can we see coming?** Like a cold east wind, we often hear of possible resistance problems that are already occurring in Manitoba. A wild mustard resistant to Sencor (Group 5) was selected in a field where a Manitoba producer was growing lentils and had used Sencor for many years.

Multiple herbicide resistant wild oats has been described, again from Manitoba. These wild oats are resistant to Hoe-Grass and other Group 1 herbicides, Assert, a group 2 herbicide and Matavan (un-grouped). The producer who has this resistant weed has few (if any) selective herbicide choices left to control wild oats. We should also be on the look out for multiple resistant wild oats. Producers with Avadex/Avenge resistant wild oats who switch to Puma, Hoe-Grass, Select or other Group 1 herbicides should be on the look out for resistance developing in their fields and - better yet to delay resistance - follow some of the suggestions below.

Another weed to watch is cleavers. Refine Extra has seen extensive use for cleaver control. Report any occurrences of poor, patchy cleavers control in a field that has been treated with Refine Extra to your local Alberta Agriculture Crop Specialist.

### Planning to Avoid Herbicide Resistance

**Resistance is a numbers game.** The more weeds you spray, the more acres sprayed with a single herbicide group, the more likely that herbicide resistance will develop. There are some things you can do if you want odds in your favor.

### 1. Reduce your use of herbicides by:

- sowing a competitive crop at the correct seeding depth and density.
- using adequate fertilizer to give your crops the competitive edge.
- placing the fertilizer where it is available to the crop, but not the weeds.
- using rotations wisely. Plant competitive cereal crops before less competitive broadleaf crops like peas and lentils to help clean up your field.
- 2. Don't treat large populations of weeds with a selective herbicide
  - Use non-selective herbicides like Roundup to control your weeds, pre-plant in spring and pre- and post-harvest in the fall.
  - Use silage or green manuring if your weeds become unmanageable.
- 3. Rotate Herbicides
  - By rotating your herbicides - by herbicide group - you can delay the onset of resistance. For details on Herbicide groups, check the Blue Book - Crop Protection with Chemicals - page 34.
  - Watch the new mixtures as many of them contain several different herbicides groups and can complicate herbicide rotations.
  - Herbicide mixtures, where two or more herbicides from different groups control the same weed, will slow down the development of resistance. Crossfire, a combination of metribuzin (Group 5) and tribenuron methyl (Group 2) both control chickweed. Crossfire should be mixed with MCPA to provide a three group mixture for chickweed control in wheat. This product is being marketed in areas where Group 2 resistant chickweed is a problem. Crossfire seems like a good short term solution and should be considered in your herbicide rotation if chickweed is your major problem weed.
- 4. Keep records
  - Keeping a record, by it self, will not change the development of resistance, but it certainly will help with planning your herbicide rotations.

Herbicide resistance looks like a patch of uncontrolled weeds. The patch is usually irregular in shape and cannot be explained by a plugged nozzle or poor sprayer overlap. A good check is to look for weeds controlled in the same patch. For example, if you sprayed Ally and you have a patch of uncontrolled chickweed, but within that patch you have control of the buckwheat and wild mustard, herbicide resistance is a good guess.

Reporting resistance will help us. You many think that Ally resistant chickweed is so common in your area that no one will care, but under-reporting leads to a misunderstanding of the scope of the problem. We would like to hear about your resistance problem whether it is common in your area or something new. We will pass the information along to other producers, agri-chem dealers, chemical companies and the agronomic community who need to keep aware of the resistance problem. For further information on resistant weeds or to report resistance, please call Linda Hall at 427-2530 or your local Crop Specialist.

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## 1995 Observations from the Field - Continued

The very dry harvest weather allowed the crop to mature without developing "in swath" sclerotinia infections, although many canola crops were cut on the green side. In wet falls, "in swath" sclerotinia infection can destroy 10 to 25% of the expected seed yield.

**Root rot** levels were low this year. Typically, a wet June

followed by very heavy rains in mid-July usually cause flooding on clay type soils. This causes root rot in canola and crops that are expected to yield 30 to 40 bushels produce 15 to 25 bushels. This year, the very dry soils absorbed the moisture reducing the incidence of root rot. A cool August allowed the canola crop to grow vigorously into September. The inevitable result was higher than average yields with a high percentage of green seed.

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## SOIL AND CROP DIAGNOSTICS , TOOLS OF THE TRADE

*Jim Letal, Unit Head, Soil and Crop Diagnostic Centre*

The Soil and Crop Diagnostic Centre (formerly the Alberta Soils and Animal Nutrition Laboratory) has not only had its name changed but its focus as well. Originally the laboratory provided routine analysis of soils for fertilizer recommendations and feeds for ration formulations. This service is now fully provided by the private sector laboratories. The new purpose of the Soil and Crop Diagnostic Centre is to provide department specialists and private sector laboratories with high quality research data, leading edge analytical methods, reference laboratory services and **diagnostic systems**.

**What are diagnostics?** Soil and crop diagnostics are valuable management tools that assist producers in minimizing inputs and maximizing profits. A diagnosis is the process of identifying a problem through examination and careful study of the symptoms - diagnostics are tools that help in the diagnosis. Soil and crop diagnostics include soil testing, weed, insect and crop damage identification. By correctly diagnosing a problem, producers can more effectively target the treatment to the problem, maximizing both yields and profit.

For Alberta potato growers in 1994, the timely diagnosis of Late Blight (*Phytophthora infestans*) followed by the appropriate fungicide application would have helped many producers who lost up to \$1,000 per acre. Alberta's weather is usually not conducive to the development of Late Blight and costly control measures are not required.

In the rare instances when Late Blight becomes a problem, the standard recommendation is a fungicide application every 7-10 days starting in late June and ending one week before top kill. This prescription costs \$50-140 per acre per year. In 1994, conditions were favorable and Late Blight became a serious problem. Many growers were caught unaware and suffered major losses. A combination of field scouting, weather monitoring, field diagnosis and timely fungicide applications will save growers unneeded input costs, ensure their effective use in the year of need, save yields and profits and reduce risks to the environment.

In order to help Crop Specialists and producers make those timely diagnoses, the Soil and Crop Diagnostic Centre developed a computerized database of laboratories in Western Canada and their diagnostic capabilities. If you want to receive a list of laboratories or a copy of the database program, please contact the Soil and Crop Diagnostic Centre at 427-6361 or fax 427-1439. (To use the database program, you require either Paradox for Windows or WordPerfect 6.1 for Windows. When ordering, please state your preference).

Soil and crop diagnostic videos and fax sheets are also available. Contact the Alberta Agriculture, Food and Rural Development Communications Department or any District or Regional Office for a list of available publications.

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## WE COULD USE YOUR HELP!

The Soil and Crop Diagnostic Centre is preparing a field diagnostic manual to assist barley producers optimize yield and quality. This manual is intended for use by both producers and researchers. Initially, the manual will be exclusively on barley, but other field crops will likely be added. The manual will include disease diagnoses, nutrient (fertility) problems, environmental problems, insect and pesticide damage problems. Input from potential users as to what would be most useful in this type of manual would be greatly appreciated. Please send your comments to:

**Dee Ann Benard**  
**Soil and Crop Diagnostic Centre**  
**905, 6909 - 116 Street**  
**Edmonton, AB., T6H 4P2**

# WHEAT, BARLEY AND CANOLA RESPONSE TO PHOSPHATE FERTILIZER (Part 1)

R.H. McKenzie, L. Kryzanowski, K. Cannon, E. Solberg, D. Penney, G. Coy, D. Heaney, J. Harapiak and N. Flore

Extensive phosphorus (P) fertilizer calibration trials with wheat, barley and canola suggest almost 75% of Alberta's soils are marginally to highly responsive to P fertilization.

Alberta soils tend to be naturally low in plant available P. The benefits of seed-placing phosphate fertilizer with wheat grown on fallow soils were first observed in western Canada in the mid 1940's. However, use of phosphate fertilizer did not become common until the 1950's and dramatically increased from the 1960's to 1980's. Phosphate fertilizer purchases in the three prairie provinces now exceed 325 million dollars annually. In the 1980's, agronomists began noting that crops did not always respond to added phosphate on soils that tested low in plant available P. Some agronomists felt that residual phosphate build-up over a period of years resulted in reduced crop response to phosphate fertilizer. This led to questioning of the accuracy of P

soil tests used by laboratories as well as questioning the need for phosphate fertilizer.

A research project to assess crop responsiveness to P fertilizer on a wide range of soil types across Alberta was conducted from 1991 to 1993. Replicated field trials with spring wheat, barley and canola evaluated P response using four application rates (0, 15, 30, and 45 kg/ha of  $P_2O_5$ ) in six major soil zones across the province. Banded and seed-placed P were compared at several locations. During the three year study, 450 sites were established, of which 427 sites were taken to completion and harvested.

Table 1 shows the numbers of sites that statistically responded to applied P. In summary, 50% of wheat sites, 55% of barley sites and 34% of canola sites significantly responded to added phosphate fertilizer at the 427 research sites.

**Table 1. Sites showing a statistically significant response to P fertilization (1991-1993).**

Soil Zones								
Crop	Response	Brown	Dark Brown	Thin Black	Black	Gray伍ooded (Central)	Gray伍ooded (Peace R.)	Total Sites
Wheat	Response	9	14	12	22	9	8	72
	No Response	7	14	14	13	10	13	73
Barley	Response	8	14	19	27	10	10	88
	No Response	8	12	18	12	9	12	71
Canola	Response	5	5	5	12	5	9	42
	No Response	10	20	13	17	10	11	81

However, statistical analysis likely underestimated the real response to phosphate fertilizer. The reason for under estimation of significantly responsive sites is due primarily to variation in yields among the treatments at a site. Even a small half acre plot site which appears level, with uniform soil, will often have some variation in soil nutrient levels. This slight variation in soil is reflected in the variations in yield among the small plot treatments.

When there is a variation in yield, this makes the task of predicting phosphate response with 95% accuracy a challenge. Table 2 summarizes the numbers of responsive and unresponsive sites based on a mean yield increase of at least 2 bu/ac.

Yield increases of 2 to 5 bu/ac occurred at 145 sites and increases greater than 5 bu/ac occurred at 204 sites. This suggests about

**Table 2. Sites showing at least a two bushel yield response to P fertilization (1991-1993).**

Soil Zones								
Crop	Response bu/A	Brown	Dark Brown	Thin Black	Black	Gray伍ooded (Central)	Gray伍ooded (Peace R.)	Total Sites
Wheat	>5	9	10	14	21	10	10	74
	2-5	1	10	9	8	6	9	43
	<2	6	8	3	6	3	2	28
Barley	>5	9	14	19	32	14	13	101
	2-5	5	12	14	3	2	6	42
	<2	2	0	4	4	3	3	16
Canola	>5	3	2	1	9	5	8	29
	2-5	8	14	11	12	8	7	60
	<2	5	9	6	8	1	5	34

## **Wheat, Barley... Continued**

82% of all sites responded to applied P. By crop, P fertilization increased yields in 81% of wheat trials, 90% of barley trials and 72% of canola trials. Seed-placed P was compared to banded P at 55 sites in central and southern Alberta. Placing the phosphate in the seedrow produced a better yield than banding in 33 of the 55 responsive sites. Banding was superior to seed-placed P in only 8 trials.

### **Summary**

Alberta soils are deficient in available P and will respond to P fertilization. From 1991 to 1993, P fertilization of spring wheat, barley and canola was evaluated in 427 field trials scattered across the six different soil zones in the province. Yield responses of at least 2 bu/ac occurred in about 75% of the trials.

The crop response data generated in this study are currently being correlated with various P soil test methods in use in laboratories across the prairies. This extensive database will improve the soil testing laboratories P recommendations for prairie farmers and should increase farmer confidence in profitability of fertilization.

The authors gratefully acknowledge funding from the Alberta Agriculture Research Institute, Alberta Canola Producers Commission, Western Grain Research Foundation, Westco, Sherritt, Cominco and the Potash and Phosphate Institute of Canada.

Part II on phosphate fertilizer response will appear in the next issue of SOILutions.

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## **DISEASE DIAGNOSIS... Sometimes more dumb luck than asking the right question!**

*Ieuau Evans, Plant Pathologist, P.I.*

It was 4:15 p.m. on October 10, I had just poured myself another coffee and was sitting back to contemplate the ever controversial subject of copper/herbicide interactions. Suddenly, my doorway was filled with a very large but healthy Colorado spruce branch that was closely followed by a local city resident. He said his 40' spruce was dying from the top down, could I help him?

Of course, I would try to help him. That's my job, that's what I do.

Close inspection confirmed what I had seen from a distance. The spruce branch was very healthy. There were green 5 year old needles on the branch and the new growth(shoots) were 4" to 6" long. There was nothing wrong with this sample, it was healthy with no disease or insect pests.

Hmmm.... This would require further investigation. So I went to examine the tree more thoroughly.

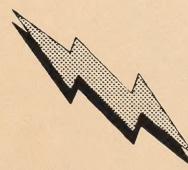
When I arrived it was obvious the tree was in trouble. The top 30' of the Colorado spruce was dying. Most of the needles had fallen off and no new growth had occurred in the last year. After many questions regarding herbicide usage and fertility rates, I was still stumped. (A tree joke, get it??) No known disease or soil toxicity (herbicide) could have caused this kind of problem. It seemed that the only possible cause was that bark boring grubs (weevil larvae) had girdled the tree. The symptoms were unusual because although weevil larvae will bore into the trunk of the Colorado spruce but they seldom girdle the tree.

I gave him my diagnosis. He paused and thought a moment, "could these insects kill my other 3 mature Colorado spruces". I replied quite flippantly, "the chances of weevils completely girdling more than one tree are about the same as being struck by lightning". He let out a small chuckle and said, "funny you should mention lightning, last August my house was struck by lightning". *It was as if a bolt of lightning had struck me.* "Was it on the side by the dying tree?" He quickly saw the direction in which I was heading. "Yes, it scorched the house's roof and damaged electrical equipment in the house".

Later in the week when he cut down the tree, he telephoned and said that scorch marks were visible near the top of the tree. No question in his mind, it was lightning damage.

I put down the phone, picked up my cup of coffee and thought to myself with satisfaction, **another case solved**.

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## DENISE MAURICE DEPARTS FOR GREENER PASTURES

After 13 years, Denise Maurice has decided to give private industry a go. Her leaving was a great shock to most of us and her knowledge and enthusiasm will be missed. A small gathering was held to say goodbye. Dr. Ieuan Evans gave a very clever tribute and we thought you all would like to hear it.

He started with something in Welsh for which there was no translation, then moved on to say:

Denise **ASSUREs** me that this move will **ADVANCE** her career. She had to **ROUNDUP** her thoughts before she could **MUSTER** up the courage and **ASSERT** her priorities. She will **ACHIEVE** her goals, **TARGET, REFINE** and **SELECT** her career path often in the **PURSUIT** of perfection. Her decision none-the-less

was a real **TRIUMPHant BONANZA** for industry. As an extension and research scientist she had no **RIVAL**. She **EDGED** them all out and was able to **HARVEST** her success.

Her move will sadden us but her presence will **PREVAIL** in her **PURSUIT** of this **VENTURE**. **WEEDONE** our best to keep her but the **VICTOR** was Westco.

Denise worked very hard to become a respected person in the industry and the demand for her time and expertise tells us that she has succeeded. We wish her all the best in the future and hope to continue benefiting from her expertise (we hope she doesn't think she is rid of us yet).

*\* Any mention of product name is not to be seen as an endorsement.*

## BERTHA ARMYWORM ON THE MARCH?

*excerpt from 1995 Alberta Insect Pest Report*  
Jim Jones, Entomologist

Bertha armyworm populations increased in the province for the first time in several years and may pose a problem to canola producers next year. Bertha armyworm infestations were centered around Vulcan, Rolling Hills and Seven Persons in the south and Provost in east-central Alberta. Estimates of the number of acres treated included:

<u>County / M.D.</u>	Number of Acres Treated
Vulcan Co.	20,000
Provost M.D.	20,000
Wheatland	14,800
Newell Co.	2,000
Cypress M.D.	1,000

Much of the spraying in the south was specifically for berthas. Aerial applications in the M.D. of Provost were split between diamondback moths and bertha armyworm.

## MEET THE SPECIALIST

**Danial Ernest Cole**  
**Weed Specialist**



Dan, an Edmonton native, graduated from the University of Alberta in 1972, with a B.Sc. specializing in Plant Science. After working for the University for three years, he spent a very

interesting two years working for CUSO in Thailand as an agricultural specialist in the area of extension. Since joining Alberta Agriculture in 1979, he has played a key role in a number of co-operative research and extension projects, including:

- biological weed control
- integrated forage research focusing on pest management, biological control and input management such as fertilizers and pesticides minor use registration weed control demonstrations.

At present, Dan has taken on the role of a student again. He is attending the University of Alberta, working with Dr. Jane King, on an M.Sc. thesis project which is looking at the integrated control of weeds in pasture and hayland.

Dan is married to Susan and they have two girls, Tracey (14) and Laura (11). He is the manager of the community league girl's basketball team, and a Sunday school teacher. Badminton, tennis, volleyball and skiing are some of the recreational activities that are enjoyed by the Cole family.

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## DEAR AGGIE

### Dear AGGIE:

*During this growing season, I have noticed an unusually high number of swollen, whitish growths in the flowers of my canola crop. Should I be concerned about yield losses? Is there any control measures which can or should be taken?*

**D. E. Formed**

### Dear D. E. Formed:

The growths which you see in your canola crop are due to white rust; commonly called staghead. White rust is caused by a fungus, which can overwinter as spores on the soil, crop residue or become mixed with the seed during harvest. In the spring it then germinates and infects the canola in the early stages. The fungus is a parasite which must have live plant material to grow on. It then forms pustules which release airborne spores causing the spread of the rust from plant to plant.

### Control:

**Grow a resistant crop.** Argentine and several polish varieties of canola are now resistant to white rust. Yield losses in the susceptible varieties are generally low but under very favorable conditions can be as high as 20 to 25%.

**Practice good crop rotation.** The white rust fungus is specific to canola and therefore can not affect other crops which are grown in the following year. The overwintering spores deteriorate over time and therefore are not as likely to cause an infestation problem if canola is not followed by canola.

**Control growth of volunteer canola at an early stage.** The volunteer canola is the only way the white rust fungus can continue its life cycle uninterrupted in a good rotation. Other members of the mustard and rapeseed family are susceptible to strains of white rust which do not affect the canola varieties.

Sincerely,  
AGGIE

### Dear AGGIE:

*Much to my dismay, I recently noticed cleavers were growing in my barley crop. However, upon closer inspection, I noticed some caterpillars eating the cleavers. They were green to black in color with a red tail and head and had a yellowish stripe down its side. Have I discovered the newest biological agent for cleavers? Are these caterpillars going to solve my cleavers problem?*

Sincerely,  
Forever Hopeful

### Dear Hopeful:

What you probably saw was the caterpillar of the Bedstraw Hawkmoth. It is native to Alberta, but is rarely seen. Only when the conditions are ideal do the populations increase to such a level that we notice them. Unfortunately, it does not feed exclusively on cleavers. It also eats other bedstraws and it is usually heavily parasitized. Therefore, the Bedstraw Hawkmoth will have little impact on your cleavers.

Concern was also raised by producers who saw these caterpillars in canola. They were worried the caterpillars were eating the canola. A closer look showed that they were dining only on the cleavers within the canola crop. Bedstraw Hawkmoths have also been observed feeding on smartweed.

Regretfully,  
AGGIE

Your letters are welcome. Please mail or fax to:

SOILutions  
Alberta Agriculture, Food and Rural Development  
905, 6909 - 116 Street,  
Edmonton, Alberta, T6H 4P2  
Phone: 427-6361  
Fax: 427-1439



## THE NEW AGRONOMY UNIT Emerges From the Old Soil and Crop Management Branch

The Agronomy Unit is one of eight program units that emerged from the Plant Industry Division reorganization.

The Agronomy Unit exists to build and deliver integrated soil, crop and pest management systems that are competitive today and are environmentally and economically sustainable for tomorrow. Developing such a system requires balance. The short term objective of minimizing costs while maximizing saleable products must be met while enhancing the longer term objectives of maintaining not only a viable business unit but a healthy and diverse ecosystem.

Our key customers are those producers and agronomists who are willing and capable of adopting leading edge crop production strategies. Our primary customers are the department's district specialists, industry agronomists and leading edge producers. We achieve our purpose by bridging the gap between basic research and applied technology. We are integrators, taking information from many sources and putting it together into knowledge based production systems.

Although most of the Agronomy Unit personnel need no introduction, there are a few new faces and some changed focuses. These are the people who make up the Agronomy Unit:

Name	Title	Phone No.
Dan Heaney	Program Manager	427-7098
Doug Penney	Soil Fertility Specialist	427-7098
Jerome Lickacz	Forage Agronomist (Fertility)	427-7098
Len Kryzanowski	Crop Nutrition Agronomist	427-6361
Ross McKenzie*	Soil Fertility Specialist	381-5126
Allan Middleton*	Agronomy Technologist	381-5126
Elston Solberg	Research Agronomist (Fertility)	427-2530
Linda Hall	Research Agronomist (Weeds)	427-2530
Dan Cole	Research Agronomist (Biocontrol /Minor Use on Forages)	427-2530
Ieuan Evans	Plant Diseases Specialist	427-7098
Jim Jones	Entomologist (moving to Edmonton as of Jan. '96 )	427-7098
Jill DeMulder	Agronomic Research Coordinator	427-2530
John Brown	Agronomy Technologist	427-2530
Beth Hoar	Agronomy Technologist	427-2530
Lloyd Davison	Agronomy Technologist	422-1789 Ex. 235
Roy Panasiuk	Agronomy Technologist	427-2530
Boris Henriquez	Agronomy Technologist	427-2530
Ed Kallal	Agronomy Technologist	422-1789 Ex. 235
Al Falkner	Agronomy Technologist	492-0178
Joan Seath	Accounts Administrator	427-7098
Lorraine Kohlman	Office Coordinator	427-7098
Faye Beier	Information Media Technician	427-7098

\* Lethbridge

The Pest Regulatory people now are in a separate unit (Pest Prevention and Management) and until further notice can be reached at 427-7098.



SOILutions is published three times a year by the Agronomy Unit, Alberta Agriculture, Food and Rural Development. Your comments on current contents, ideas and contributions for future articles are welcome. Editors: J. DeMulder, I. Evans, D. Penney. For further information phone, fax or write to:

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